

## In-Space Manufacturing Development and Demonstration

Completed Technology Project (2011 - 2012)



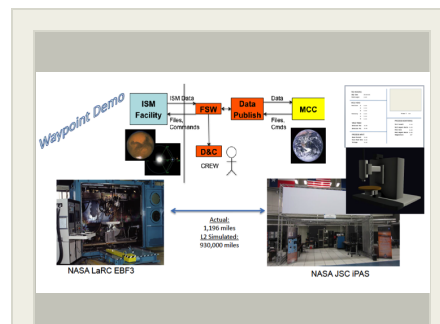
## Project Introduction

In-space manufacturing provides the opportunity to build replacement parts on-demand and repair structure to change the paradigm for space exploration mission supportability. Advanced Manufacturing technology such as additive manufacturing and electron beam welding are being developed and utilized on earth but have not yet been adapted to an in-space system context. This project demonstrated the concept of operations for an in-space manufacturing system.

In-space manufacturing provides the opportunity to build replacement parts on-demand and repair structure to change the paradigm for space exploration mission supportability. Advanced Manufacturing technology such as additive manufacturing and electron beam welding are being developed and utilized on earth but have not yet been adapted to an in-space system context. The objective of this project is to demonstrate the concept of operations for an in-space manufacturing system. Due to the small-scale of this project and the large cost of advanced manufacturing technology systems, sub-element technology demonstrations were completed. Additive manufacturing concept of operations was demonstrated with the help of JSC's integrated Power, Avionics, and Software facility. A data connection was created between the iPAS flight computer in Houston, TX and LaRC's Electron Beam Freeform Fabrication (EBF3) additive system in Hampton, VA to simulate remote manufacturing. Crew displays and controls were developed and integrated with the iPAS Flight Deck of the Future. A technology demonstration was completed as part of the iPAS asteroid demonstration. Finally, metal and plastic material specimens and parts were fabricated for structural testing and evaluation. Space structure repair was tested by evaluating weld-positioning capability of the Dexterous Manipulator Trainer (DMT), the ground version of the Special Purpose Dexterous Manipulator (SPDM) currently on the International Space Station. DMT positioning testing determined that the SPDM would be useful for gross positioning but fine positioning would be too challenging. JSC's Robonaut, which is still in development, was also tested and performed more adequately for fine positioning tasks, though it's still unclear if it performed well-enough for on-orbit welding.

## Anticipated Benefits

The International Space Station currently has a risk for micrometeoroid orbital debris damage (MMOD) to the pressure wall. With an on-orbit electron beam weld capability, NASA would be able to restore structural integrity to the ISS and recover from potential catastrophic damage.



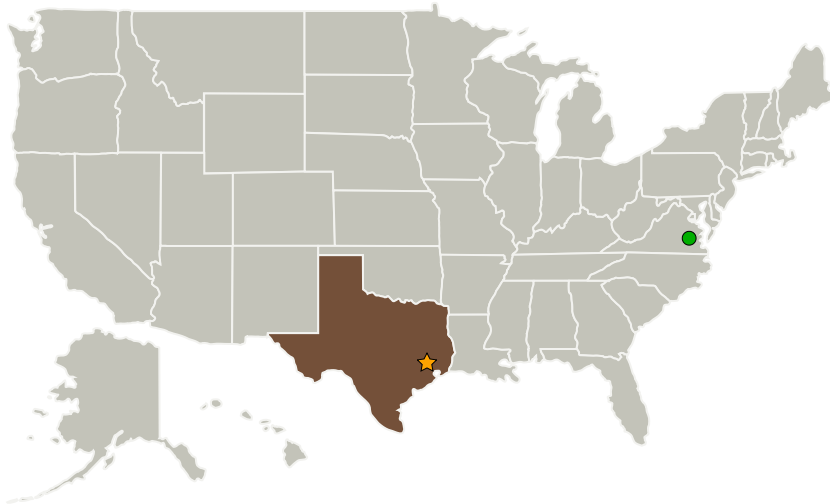
Project Image In-Space Manufacturing Development and Demonstration

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## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Johnson Space Center(JSC)	Lead Organization	NASA Center	Houston, Texas
● Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

### Primary U.S. Work Locations

Texas

## Organizational Responsibility

### Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

### Lead Center / Facility:

Johnson Space Center (JSC)

### Responsible Program:

Center Innovation Fund: JSC CIF

## Project Management

### Program Director:

Michael R Lapointe

### Program Manager:

Carlos H Westhelle

### Project Manager:

Michael C Waid

### Principal Investigator:

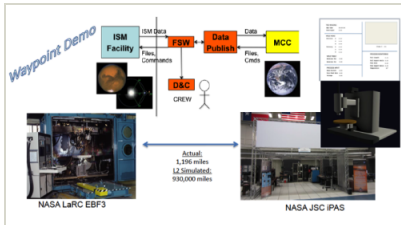
Michael C Waid

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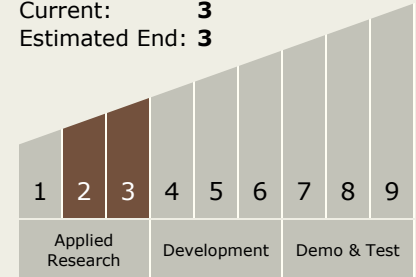
## Images

**12155-1379725239965.png**Project Image In-Space  
Manufacturing Development and  
Demonstration

(https://techport.nasa.gov/image/2307)

Technology Maturity  
(TRL)

Start: 2  
Current: 3  
Estimated End: 3



## Technology Areas

## Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.4 Manufacturing
    - TX12.4.1 Manufacturing Processes